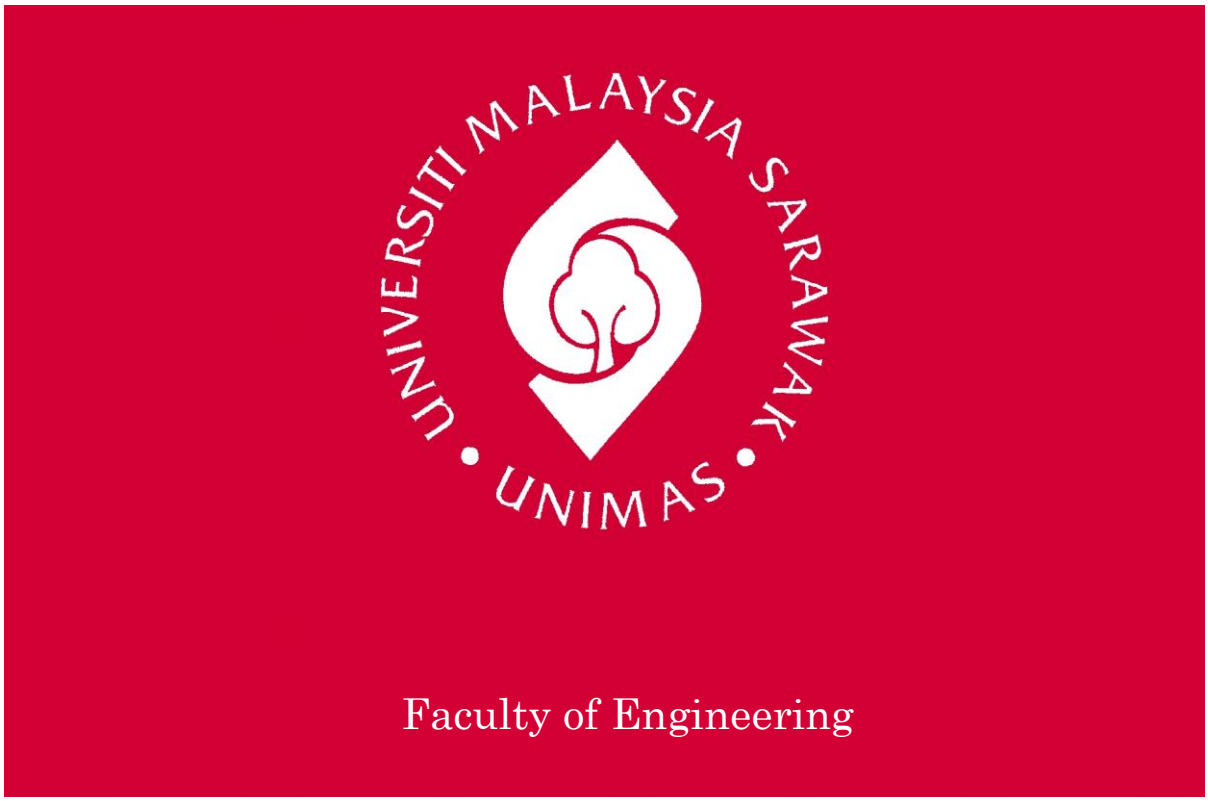

RISK ASSESSMENT FOR RIVER TRANSPORT: KUCHING EXPRESS BOAT PASSENGER TERMINAL (MAINTENANCE & UTILIZATION)

FRANKLIN SIMON

Bachelor of Engineering with Honours
(Civil Engineering)
2010

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This thesis is dedicated to my beloved father and mother,

who have taught me that best kind of knowledge

to have is that which is learned for its own sake

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ABSTRAK

Pembangunan sistem pengangkutan air di Sarawak, Malaysia masih dianggap berada pada peringkat awal. Terdapat kemungkinan bahawa sistem pengangkutan air di Sarawak boleh dipertingkatkan dan dijadikan salah satu penyumbang untuk menaik tarafkan sistem pengangkutan air dalam negeri ini. Terminal Penumpang Bot Ekspress Kuching, Lembaga Sungai-Sungai Sarawak merupakan sasaran utama dalam kajian ini. Kajian ini melibatkan penilaian risiko kualitatif dan kuantitatif terhadap penyenggaraan dan penggunaan terminal. Kajian ini dijangka akan menyumbang kepada pembangunan industri sistem pengangkutan air di Sarawak. Pengedaran soalan-soalan survei untuk tujuan penilaian risiko kualitatif dan satu kaedah yang dikenali sebagai *Fuzzy Failure Mode dan Effect Analysis (FMEA)* telah diadaptasikan untuk menjalankan penialain risiko kuantitatif terminal tersebut. Jadual kedudukan skala pengkadaran untuk keterukan, peristiwa dan pengesanan telah digunakan untuk menjalankan kaedah *fuzzy FMEA*. Daripada analisa yang telah dijalankan, nilai *fuzzy risk priority number (RPN)* tertinggi telah diperolehi daripada komponen rakit-rakit keselamatan (351, 323 sekiranya ternormal) dan nilai *fuzzy RPN* terendah pula didapati daripada komponen pagar-pagar (83.9, 5 sekiranya ternormal). Rakit-rakit keselamatan telah ditarafkan sebagai tertinggi dan pagar-pagar pula ditarafkan sebagai terendah dalam kedudukan nilai *fuzzy RPN*. Walaubagaimanapun, nilai-nilai yang telah diperolehi daripada kaedah ini didapati tidak menyokong nilai teori disebabkan beberapa kelemahan-kelemahan seperti wujudnya ‘lubang-lubang’ dalam fungsi-fungsi keahlian. Peningkatan pada masa depan melibatkan kaedah ini adalah seperti pengubahsuaian jadual kedudukan skala pengkadaran supaya kaedah ini dapat disesuaikan untuk menjalankan penilaian risiko

terhadap mana-mana infrastruktur sungai. Kesimpulannya, kaedah *fuzzy FMEA* ini telah dibuktikan dapat diaplikasikan dalam penilaian risiko sesebuah infrastruktur sungai dari segi penyengaraan and pengunaan.

ABSTRACT

The development of water transport in Sarawak, Malaysia is considered to be in the early stages. There are possibilities that the water transport system in Sarawak can be improved and made a contributor to enhancing the public transportation system in the state. The Sarawak Rivers Board, Kuching Express Boat Passenger Terminal was the targeted area of study. This study focused on the conducting of qualitative and quantitative risk assessment on the maintenance and utilization of the passenger terminal. Such studies have yet to be performed in the state. Therefore, this study will benefit the development of the water transport industry in Sarawak. Distribution of survey questionnaires were carried out for the qualitative risk assessment while a method known as the Fuzzy Failure Mode and Effect Analysis (FMEA) has been adopted for the quantitative risk assessment. Furthermore, scale ranking table of ratings for severity, occurrence and detect were used to carry out the fuzzy FMEA method. Results obtained from the fuzzy FMEA method were in the form of fuzzy RPN number, which are the products of severity, occurrence and detect. From the analysis, life rafts have the highest fuzzy RPN at 351 (323 if normalized) while the lowest fuzzy RPN was obtained from railings (83.9, 5 if normalized). Life rafts were rated highest while railings were rated lowest in the fuzzy RPN number rankings. However, values obtained from the method were not as projected theoretically due to its shortcomings, such as existence of loop holes in membership functions. Future improvements of the method may include the modification of the scale tables to suit better risk assessment for any river infrastructure. In conclusion, the fuzzy FMEA method was proven to be applicable in conducting risk assessment on a river infrastructure in terms of maintenance and utilization.

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LIST OF ABBREVIATIONS

BBN	-	Bayesian belief networks
D		Detect
EMV	-	Expected monetary value
FIS	-	Fuzzy Inference System
FMEA	-	Failure Mode and Effect Analysis
IWT	-	Inland Waterway Transport
JSA	-	Job Safety Analysis
MF	-	membership functions
O		Occurrence
RL	-	risk levels
RPN	-	risk priority number
S		Severity
SRB	-	Sarawak Rivers Board
SWOT	-	Strengths, Weakness, Opportunities and Threats
TriMF	-	Triangular membership functions
UNDP	-	United Nations Development Programme

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CHAPTER 5

DISCUSSION

5.1 Introduction

The focus of this chapter was to discuss data and results from Chapter 4. Two sections inclusive of the quantitative risk assessment and qualitative risk assessment were shown in this chapter. Discussions were carried out on the results and data from Experts' Meetings and distribution of survey questionnaires.

5.2 Quantitative Risk Assessment: Experts' Meeting and Fuzzy FMEA method

The Experts' Meeting was formed for the purpose of this study to conduct risk assessment on the Sarawak Rivers Board, Kuching Express Boat Passenger Terminal. Accordingly, the experts involved were identified as all officers and qualified staff members of Sarawak Rivers Board who are also directly involved in the day to day running of the passenger terminal. Additionally, they have adequate

knowledge and experience to fulfill the requirements for the Experts' Meeting and FMEA methodology. From the Experts' Meeting, 8 components were being studied including pontoons, railings, walkway, gangway, life jackets, life buoys, life rafts and the public washroom. A set of value of severity (S), occurrence (O) and detect (D) were obtained for each of these components. Fuzzy FMEA method was chosen to analyze the results obtained from the Experts' Meeting by the help of MATLAB version 7.0.0.19920 (R14). Results from the Experts' Meeting were compared with respondents' response to survey questionnaires for study purposes.

5.2.1 Fuzzy FMEA

Fuzzy FMEA and other FMEA methods alike have already been carried out in past researches such as on a public bus system (Hwang *et al.*, 2000) or on a fishing vessel (Pillay & Wang, 2003). However, this method has yet to be applied for the study of risk assessment of an express boat terminal.

Tay & lim (2008) mentioned that the assessment and prioritization of failure risk are to be carried out on experts' knowledge. For this study, the experts' meeting has been conducted with the experts' knowledge to be considered the most important consideration in risk assessment. Determination of the 8 components to conduct risk assessment upon were carried out with respect to experts' knowledge. Furthermore, experts ranked the severity, occurrences and detection in accordance to their

experience and knowledge of managing and working at the express boat passenger terminal.

Several important factors that had to be determined from the Experts' Meeting were such as the potential failure, potential effect and potential cause of failure for each of the 8 components. Potential failure are for examples breaking, cracking or leakage of the components. Potential effect of the failure are the consequences of the failure to the users and depending on the severity of the risk it could prove harmful to users. Potential cause of failure refers to the source of failure whether it could occur from poor quality of the component or the component was not manage properly.

Since life rafts had the highest fuzzy RPN number, this component was ranked as the first or most high risk compared to other components. The severity of the risk of life rafts may include failure of inflating or there could be leakage on the raft. On the contrary, it was also known that risk is associated to hazard, which is a substance such as the life rafts that can cause harm as according to Ridley (1994). Insufficient quantity of life rafts may also be a very dangerous threat to users. This posed as a hazard to the users in times of emergency. Such hazard could be caused by inadequate inspection of rafts or there are simply not enough provided to accommodate maximum passenger capacity. If the results from the Experts' Meeting are compared with the results from the survey questionnaire, most respondents would rate the severity of life rafts failure to be at 6.579 (Moderate) at average compared to the experts rating of severity, which was rated at 8 (High). However, life rafts were considered to be medium risk (low-medium if normalized) as according to the fuzzy RPN result. Thus, it could be mentioned that both experts' and respondents'